Available online at www.sciencedirect.com
ScienceDirect
Advances in Space Research 39 (2007) 46–51
ADVANCES IN SPACE RESEARCH (a COSPAR publication)
www.elsevier.com/locate/asr

Ground surface conditions of oases around the Taklimakan Desert

T. Ishiyama [a,*], N. Saito [a], S. Fujikawa [b], K. Ohkawa [b], S. Tanaka [b]

[a] Center for Environmental Remote Sensing, Chiba University, 1-33 Yayoi, Inage, Chiba 263-8522, Japan
[b] GEOTECHNOS Co. Ltd, 5-10-5, Shimbashi, Minato-Ku, Tokyo 105-0004, Japan

Received 19 November 2004; received in revised form 16 February 2006; accepted 26 February 2006

Abstract

Land cover change of the oases surrounding Taklimakan Desert in Xinjiang Uyghur in the past 40 years was examined by means of satellite images. From the results of the analysis of these images, the following have been explained. The farmland utilization ratio in average stands at 0.28 in the northern edge of Taklimakan Desert. In the meantime, the ratio stands at 0.13 in the southern edge, whereas 0.31 in the western edge. It is revealed that in the northern edge, area of the irrigation land is vast enough to be utilized. Small oases are much noticed generally in the southern edge, and accounted for usually less than 0.15 resulting in lowness in the utilization ratio of the farmland. However the smaller the value of the said ratio is, the higher the potential of the farmland development is. It is explained that the vegetation land is slightly expanded in the upper reaches of the river in the small oases in the northern edge, but the vegetation land is drastically changed to barren land in the lower reaches of the river. On the other hand, it is explained that the vegetation regions are being expanded year by year in the oases in the northern edge. Especially in Aksu, the farmland area was expanded accompanied with increase of the number of the development settlers.

Keywords: Desertification; Land cover change; Taklimakan Desert; Oasis

1. Introduction

In recent years, it is reported that wide area of the land has been rapidly converted into sandy sites in the edges of the oases in Taklimakan Desert in the northern part of Xinjiang Uyghur, China, and is suffering from violence of dust storms. Although the cause of the land being converted into sandy sites are not yet explained, it is widely conceived that overlapped actions between the change of weather or climate and human activities, e.g., overgrazing of livestock, outrageous lumbering, land degradation brought about by execution of inadequate irrigation onto farmland, etc., are the causes (Zhu and Wang, 1996; Wang, 1996).

To explain how the land cover change in the regions surrounding Taklimakan Desert is, analysis was made by using the data of the earth observation satellites with the investigation of the distribution of the oases surrounding Taklimakan Desert and the land cover change in Pishan Oases in the southern edge and in the vicinities of the Aksu Oases in the northern edge, especially with the fluctuation in the vegetation regions (Ishiyama, 2003).

2. Distribution of the oases in Taklimakan Desert and the district surrounding them

The oases of Takilamakan Desert comprise the river water from the mountains in the vicinities of the desert and a tiny amount of the underground water, and change of the horizontal distribution of the vegetation density of the farmland of the oases and desert regions is quite drastic. In Fig. 1, a distribution map of the vegetation indices of the Takilamakan Desert obtained by analyzing TERRA/MODIS data is shown. Great oases are noticed on an alluvial fan in the western end on Pamir Plateau and Tianshan Mountains in the western end and northern edge

* Corresponding author.
E-mail address: ishiyama@ceres.cr.chiba-u.ac.jp (T. Ishiyama).

0273-1177/$30
doi:10.1016/j.asr.2006.02.053

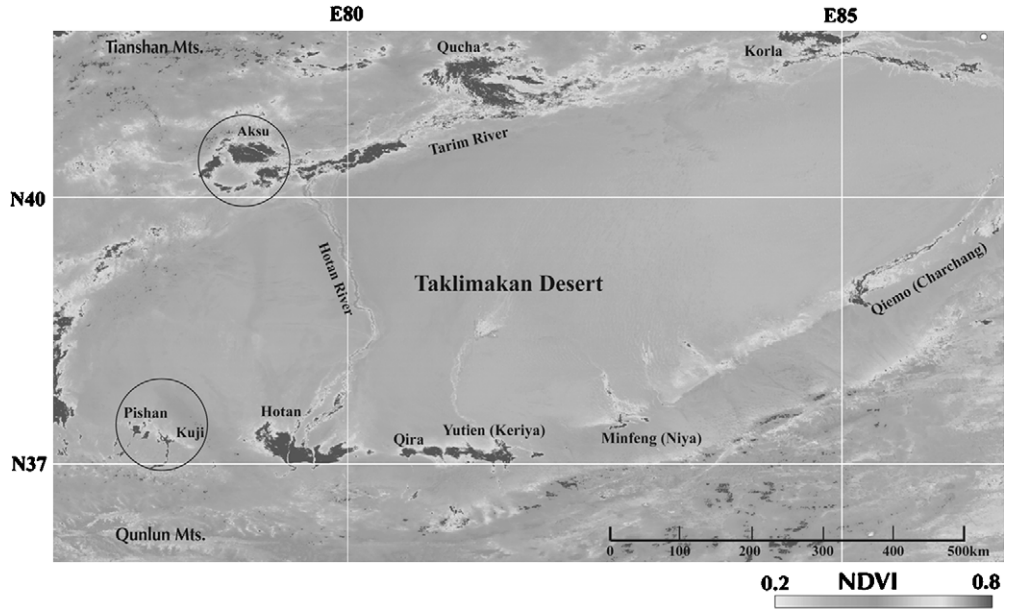

Fig. 1. Distribution of vegetation index of whole Taklimakan Desert derived from TERRA/MODIS data (May 1, 2000). The circles indicate the test sites in this study.

of Takilamakan Desert. On the other hand, the oases on the southern edge that have developed on an alluvial fan of Qunlun Mountains are relatively small in comparison with the one referred to above. Thus, it is understood that the longitudinal width is shorter than the one of the western edge and of the northern edge.

In Table 1, the area of the oases surrounding Takilamakan Desert that is calculated from MODIS data is shown. The area in question is obtained from the number of the pixels of the vegetation indices calculated from the satellite data. As the introduction equation of the vegetation indices, normalized vegetation indices (NDVI) were used. At this stage, NDVI (0.4–0.9) takes up the district ranging from a region of open vegetation to a region with high vegetation density as an objective. In this study, the regions shall be expressed as cultivatable land. On the other hand, the vegetation indices (HDNDVI: high density NDVI, 0.6–0.9) indicates an inner oases farmland with high vegetation density. The area ratio of both the former and the latter can be expressed as farmland utilization ratio (=irrigation land/cultivatable land). The values of the land utilization ratio in average are 0.28 on the northern edge of Takilamakan Desert, 0.13 on the southern edge, and 0.31 on the western edge, according to Table 1. Akus and Qucha in the northern edge and Yarkand and Kashgar in the western edge are oases exceedingly immense, and the utilization area of the irrigation land is shown to be particularly vast. On the contrary, oases rather small in comparison with those in the northern or western edge are generally found in the southern edge. The ratio of the area of the individual oases is usually lot less than 0.15, and the utilization ratio of the farmland is very low. However the smaller the value of the ratio is, the higher the potential of the farmland development is. It is made known that the utilization of the farmland is also low in Hotan in the southern edge, which is a relatively great oasis.

Table 1
Areas of cultivated (NDVI; 0.4–0.8) and irrigation (HD-NDVI; 0.6–0.8) land of oases around Taklimakan Desert derived from MODIS data

Oasis	Cultivated land (km^2)	Irrigation land (km^2)	Delta	Ratio of NDVI
Northern				
Aksu	2830.3	486.6	969	0.17
Awat	709.9	549.0	160.9	0.78
Qucha	4114.0	378.0	3736	0.09
Korla	843.3	340.6	502	0.40
Yuli	1539.9	260.1	1280	0.17
				Average 0.32
Western				
Yarkand	3290.7	1277.4	2014	0.399
Kashgar	3017.8	670.9	2347	0.222
				Average 0.31
Southern				
Qiemo	846.5	97.6	749	0.115
Yutien	1,060.2	125.5	934	0.118
Qira	421.4	68.7	352	0.163
Hotan	2,464.9	365.9	2099	0.148
Pishan	296.9	41.9	255	0.141
				Average 0.14

3. Land cover change in the southern and northern edges in Takilamakan Desert

3.1. Land cover change in the oases in the southern edge

To examine the land cover change in the southern edge in Takilamakan Desert, comparison was made among the different images obtained from the earth observation